

Please amend the claims as follows:

[c1] (Currently Amended) A method of extracting information about a system of nuclear spins from a region of an earth formation comprising:

Performing a plurality of nuclear magnetic resonance measurements on the system of nuclear spins;

Acquiring nuclear magnetic resonance data from each of the plurality of nuclear magnetic resonance measurements;

Computing a multi-dimensional dataset from an inversion process performed on the nuclear magnetic resonance data that is independent of prior knowledge of the region and does not require a regularization parameter.

[c2] (Original) The method of claim1, further comprising the step of:

Generating a multi-dimensional graph of the multi-dimensional dataset.

[c3] (Original) The method of claim 2, wherein the multi-dimensional graph is expressed along a set of axes selected from the group of diffusion, T1, T2 and a ratio of T1 and T2.

[c4] (Original) The method of claim1, further comprising the step of:

Compressing the nuclear magnetic resonance data prior to computing the multi-dimensional dataset.

[c5] (Original) The method of claim 4, wherein compressing the nuclear magnetic data comprises transforming the data using a singular value decomposition.

[c6] (Original) The method of claim1, the computing step further comprising the step of:

Evaluating a plurality of functions,  $M_n(x_i)$ , whose expectation values define the moments,  $\bar{M}_n = \sum_i M_n(x_i) f(x_i)$  where  $f(x_i)$  is the object distribution function, which is also

expressed in terms of the same functions  $f(x_i) = Z^{-1} \exp\left(\sum_n \alpha_n M_n(x_i)\right)$ , where  $\alpha_n$  are parameters

which are adjusted such that the moments computed using  $\bar{M}_n$  and  $f(x_i)$  agree with the nuclear magnetic resonance data.

[c7] (Original) The method of claim 6, the evaluation step further comprising the steps of:

Comparing the computed moments  $\overline{M}_n$  with a set of data moments obtained from the nuclear magnetic resonance values;

Determine a fit quality between the computed moments  $\overline{M}_n$  and the set of data moments;

Determine a final distribution when the fit quality is within a tolerance limit.

[c8] (Original) The method of claim 7, the evaluation step further includes the step of:

Adjusting  $\alpha_n$  to improve the fit quality.

[c9] (Original) The method of claim 6, wherein the computation step provides a distribution which is simultaneously consistent with all the available data and has the maximum entropy,  $S$ , as given by  $S = -k \sum_i \ln(f(x_i))f(x_i)$ , where  $k$  is a constant.

[c10] (Original) The method of claim 6, wherein a number of  $N$  significant moments functions is determined based on the plurality of moments,  $\overline{M}_n$ , having a value above a noise level associated with the nuclear magnetic resonance data.

[c11] (Original) The method of claim 10, wherein the number of parameters,  $\alpha_n$ , used to fit the data should not exceed the number of the moment functions  $N$ .

[c12] (Original) The method of claim 6, wherein each moment within the computed moments  $\overline{M}_n$  is independent of each other computed moment.

[c13] (Original) The method of claim 1, wherein the inversion process is independent of a regularization parameter.

[c14] (Original) The method of claim 1, wherein the inversion process is independent of a specific measurement sequence.

[c15] (Currently Amended) A logging apparatus comprising:

A logging tool that is movable through a borehole; and

A processor coupled to the logging tool, the processor being programmed with instructions which, when executed by the processor, perform the steps of:

Perform a plurality of nuclear magnetic resonance measurements on the system of nuclear spins;

Acquire nuclear magnetic resonance data from each of the plurality of nuclear magnetic resonance measurements;

Compute a multi-dimensional dataset from an inversion process performed on the nuclear magnetic resonance data that is independent of prior knowledge of the region and does not require a regularization parameter.

[c16] (Original) The logging apparatus of claim 1, the processor further performing the step of:  
Generating a multi-dimensional graph of the multi-dimensional dataset.

[c17] (Original) The logging apparatus of claim 2, wherein the multi-dimensional graph is expressed along a set of axes selected from the group of diffusion, T1, T2 and a ratio of T1 and T2.

[c18] (Original) The logging apparatus of claim 1, the processor further performing the step of:  
Compressing the nuclear magnetic resonance data prior to computing the multi-dimensional dataset.

[c19] (Original) The logging apparatus of claim 4, wherein compressing the nuclear magnetic data comprises transforming the data using a singular value decomposition.

[c20] (Original) The logging apparatus of claim 1, the computing step further comprises the step of:

Evaluating a plurality of functions,  $M_n(x_i)$ , whose expectation values define the moments,  $\bar{M}_n = \sum_i M_n(x_i) f(x_i)$  where  $f(x_i)$  is the object distribution function, which is also expressed in terms of the same functions  $f(x_i) = Z^{-1} \exp\left(\sum_n \alpha_n M_n(x_i)\right)$ , where  $\alpha_n$  are parameters which are adjusted such that the moments computed using  $\bar{M}_n$  and  $f(x_i)$  agree with the nuclear magnetic resonance data.

[c21] (Original) The logging apparatus of claim 6, the evaluation step further comprises the steps of:

Comparing the computed moments  $\overline{M}_n$  with a set of data moments obtained from the nuclear magnetic resonance values;

Determine a fit quality between the computed moments  $\overline{M}_n$  and the set of data moments;

Determine a final distribution when the fit quality is within a tolerance limit.

[c22] (Original) The logging apparatus of claim 7, the evaluation step further includes the step of:

Adjusting  $\alpha_n$  to improve the fit quality.

[c23] (Original) The logging apparatus of claim 6, wherein the computation step provides a distribution which is simultaneously consistent with all the available data and has the maximum entropy,  $S$ , as given by  $S = -k \sum_i \ln(f(x_i))f(x_i)$ , where  $k$  is a constant.

[c24] (Original) The logging apparatus of claim 6, wherein a number of  $N$  significant moments functions is determined based on the plurality of moments,  $\overline{M}_n$ , having a value above a noise level associated with the nuclear magnetic resonance data.

[c25] (Original) The logging apparatus of claim 10, wherein the number of parameters,  $\alpha_n$ , used to fit the data should not exceed the number of the moment functions  $N$ .

[c26] (Original) The logging apparatus of claim 6, wherein each moment within the computed moments  $\overline{M}_n$  is independent of each other computed moment.

[c27] (Original) The logging apparatus of claim 1, wherein the inversion process is independent of a regularization parameter.

[c28] (Original) The logging apparatus of claim 1, wherein the inversion process is independent of a specific measurement sequence.